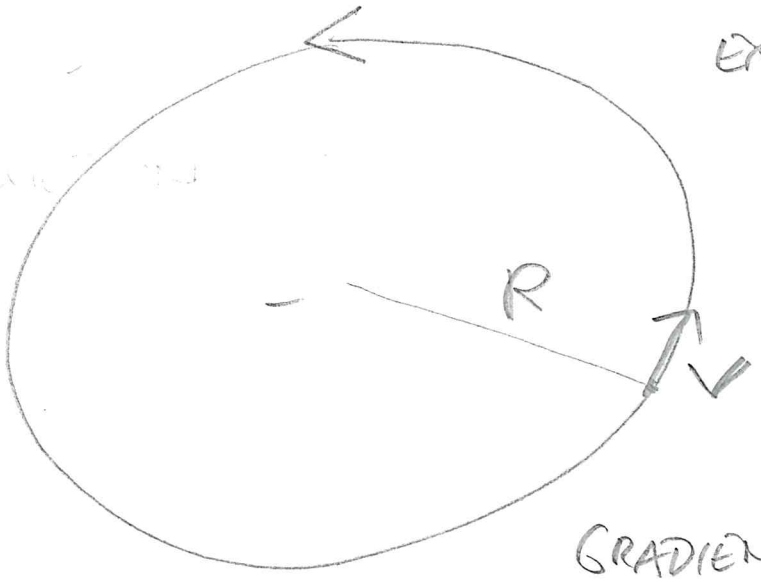
c) CENTRIFUGAL ACCELERATION

$$a = \frac{V^2}{R}$$

CURVATURE
R = RADIUS OF MOTION

REFINED CORRECTION TO GEOSTROPHIC WIND:
GRADIENT WIND V_G

$$\frac{-\frac{\partial p}{\partial x}}{\rho} = 2 \sin\phi \, \omega_0 \cdot V_G + \frac{V_G^2}{R}$$



EX: LOW PRESSURE IN NORTHERN HEMISPHERE

GRADIENT WIND

$$V_G^2 + (2 R \omega_0 \sin\phi) \cdot V_G + \frac{\frac{\partial p}{\partial x} \cdot R}{\rho} = 0$$

$$V_G = -R\omega_0 \sin\phi \pm \sqrt{R^2 \omega_0^2 \sin^2\phi - \frac{\frac{\partial p}{\partial x} R}{\rho}}$$

TO ASSESS RELEVANCE OF CENTRIFUGAL FORCE

COMPARE

$$\boxed{2 \sin\phi \cdot \omega_0 V_G} \quad \text{WITH}$$

↑ CORIOLIS

$$\boxed{\frac{V_G^2}{R}}$$

↑ CENTRIFUGAL

OR COMPUTE RATIO

$$\frac{\text{CORIOLIS}}{\text{CENTRIFUG}} = \frac{2 \cdot \sin\phi \; \omega_0 \cdot R}{V_G}$$

$$\phi \approx 50^\circ \rightarrow \sin\phi \approx 0.75$$

$$\omega_0 = \frac{2\pi}{24 \cdot h}$$

HIGH-ALTITUDE WIND SPEED : $V_G \approx 50 \text{ km/h}$

CYCLONE SIZE : $R \approx 500 \text{ km}$

$$\frac{\text{CORIOLIS}}{\text{CENTR.}} \approx \frac{2 \cdot 0.75 \cdot 2\pi \; h \; 500 \text{ km}}{24 \cdot h \quad 50 \text{ km}}$$

$$\approx \frac{1.5 \cdot 6 \cdot 100}{24}$$

$$= \frac{9}{24} \cdot 100 = \frac{3}{8} \cdot 100 \approx 37$$

FOR HURRICANES, HAVE SMALLER RADIUS & HIGHER SPEEDS: CENTRIFUGAL FORCE MATTERS (AND SLOWS DOWN WIND)

d) FRICTION

FRICTION IS COMPLEX AND DEPENDS ON SURFACE PROPERTIES, BUT IT GENERALLY SLOWS DOWN THE AIR (IN THE ABL).

THIS ALSO DECREASES CORIOLIS & CENTRIFUGAL FORCES, AND DEEP DOWN WINDS TEND MORE TOWARDS THE DIRECTION OF NEGATIVE PRESSURE GRADIENTS.

AT THE EARTH'S SURFACE, THE WIND IS ZERO.

WIND SHEAR IS OFTEN DESCRIBED BY A LOGARITHMIC PROFILE

$$v(z) = \frac{V_0 \cdot \log\left(\frac{z}{z_r}\right)}{\log\left(\frac{z_0}{z_r}\right)}$$

WITH V_0 = SPEED AT ALTITUDE $z = z_0$ AND

z_r = "ROUGHNESS LENGTH"

(A FEW MILLIMETERS FOR FLAT GROUND